International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 5 Issue 9 ǁ September. 2017 ǁ PP. 07-10

Modified Lifestraw water Filter for Use in Western Kenya

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ABSTRACT: Since the arrival of the award winning Lifestraw[R] products the year 2010 in western part of Kenya in Mumias town from Switzerland based company called Vestergaard, It has faced major challenge when it comes to refilling it with water. Users have found it difficult to refill it manually by getting impatient resulting to some of them abandoning the filters and misusing them hence jeopardizing the project. This project research aimed at modifying these filters for a self-refilling mechanism using locally available materials in the area of study (Mumias town in Kakamega County). It is hoped that the use Lifestraw will continue with the added modification.

Keywords: Lifestraw, Modification, Western, Kenya

Date of Submission: 30 -08-2017 Date of acceptance: 20-09-2017

I. INTRODUCTION

One of the most essential nutrients for human life is water. According to Gleick, 1996, a person requires 50 litres per day of which 2.9 litres in case of men and 2.2 litres for women should be drank directly and not in form of beverages, soups or foods to avoid dehydration (Kleiner, 1999). Despite the fact that access to clean water, sanitation and hygiene is a human right issue approximately 1.8 billion in the world use sources of water that are contaminated with faecal matter. This threatens life of children under five years old and it is estimated that 800 children die daily from diarrhoeal diseases linked to poor hygiene. That is why Sustainable Development Goals are founded on proper water and sanitation (Sustainable Development Goals, 2016). Worldwide technologies have been developed and are used to treat water in resource poor areas either physically or chemically at the point of consumption (Gerba & Onyango-Ouma, 2011). One such technology is LifeStraw[TM] designed by Vestergaard-Frandsen (VF) Company based in Switzerland. LifeStraw were donated to people in western Kenya to reduce the effect of drinking water challenges. Some of the other household water treatment technologies used in western Kenya include dilute hypochlorite solution, porous ceramic filtration, combined flocculants-disinfectant powdered mixture (Albert *et al.* 2010) as well as boiling.

The use of LifeStraw family has been a challenge in Western Kenya when it comes to refilling the filter and thus making it slow (Pickering *et al*., 2016). This idea of refilling water every second, minute, hour means that people grow impatient and thus leading to people stopping the usage of LifeStraw as has been observed in Ethiopia by Albert *et al*., 2010 . Another study by Pickering *et al*., 2016 found a 19% usage of filters in household with pregnant mothers after 2-3 years for filters that were distributed in Western Kenya. The challenge in refilling the filter means that if one was to consume water he or she is likely to consume microbiologically contaminated water. Therefore, there is need to modify the LifeStraw to ensure continuous refilling of filter resulting in available of safewater at all times for individuals of homestead and someone who might pop into the homestead. Despite LifeStraw being an award winning innovation it has been misused by some residents in western Kenya. The residents have modified the filters as flower vessels (Figure 1) and bicycle hooting devices (Figure 2). This paper, therefore, intends to modify the Lifestraw Family so that it can be still be used in Mumias town. The idea is to ensure that local materials are used to improve the existing filter.

Figure 1

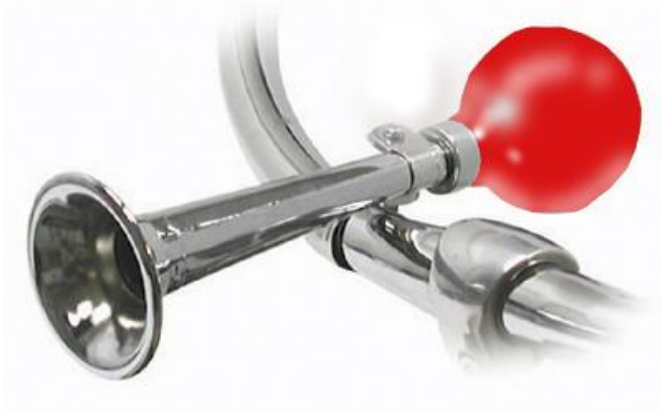

Figure 2

Some modifications already done include Aqueduct bicycle filter ensures continuous supply of filtered water as one rides the bicycle (Mullery, 2013 or team aqueduct). In addition, Lifestraw has been modified to allow children to use them effectively, (Vestergaad Friendsen). The main objective is to fabricate a modified LifeStraw filter for use in Mumias area.

II. METHODOLOGY

2.1 Study area

The area of study was in western Kenya in Kakamega County at Mumias town. Mumias situated at 0.34^0 North latitude, 34.490 East longitude and 1258 meters elevation above sea level. This area of study was chosen because of declining use of Lifestraw filters due to manual refilling of the filter and focus on addressing this problem. Sources of water in Mumias town are from wells, springs and rivers such as river Nzoia and Lusumu which are relied by the locals.

2.2 Determination of the problems with LifeStraws

Sampling was conducted in the main market road/bodaboda shade during market day using snowball approach to get to the end users of LifeStraw filters and find out the kind of misuse on LifeStraw filters. i.e. bicycle horns and flower vessels. Fifty respondents of whom majority were women were asked the following four questions.

1. Is refilling Life Straw 1.0 water filter manually a problem?
2. Has LifeStraw 1.0 water filter has served you for a long period as intended?
3. Is Life Straw 1.0 water filter being misused?
4. Have you been boiling water after abandoning the use of Life Straw 1.0 filter?

2.3 Conceptual model

The conceptual model of the improvement is shown in Figure 3.

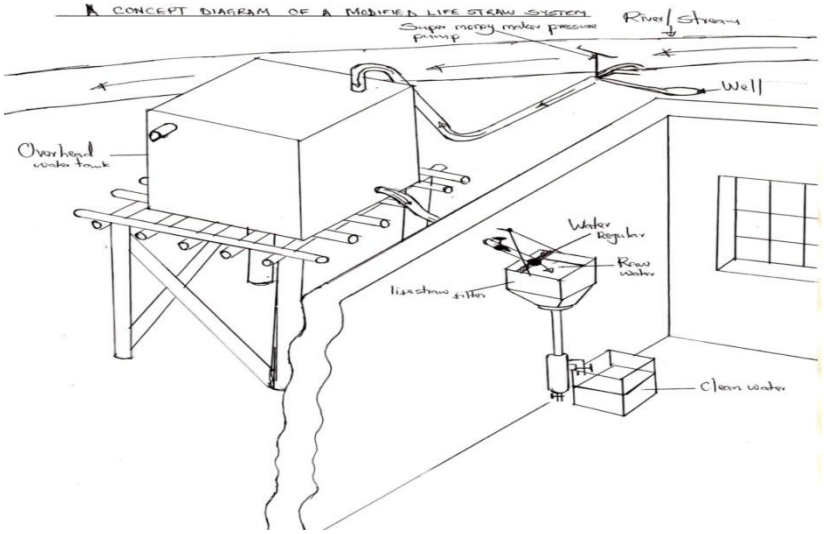

Figure 3: A Concept diagram of a modified LifeStraw Family

2.3.1 Local materials needed

Material used was based on use of used plastics, rubber among others as tabulated in Table 1.

Table 1 Local materials and their uses in making the modification

No.	Materials	Type / size	Use
1	Plastics		Make parts of water regulator i.e. accumulator.
2	Rubber		Fabricate the stopper and other sections of water regulator.
3	Wire	Aluminum	Fabricate the clamp and the collar of the regulator.
4	Adhesive	Waterproof	Attach together sections of the regulator in contact or under water.
5	Plastic container	40 liter	Main reservoir to carry water to be filtered
6	Rubber pipe	4 meters	Connect the main reservoir and the Lifestraw filter and allow water flow to Lifestraw filter through WR.

III. Results

3.1 Results obtained from the interview

All the respondents said that refilling the LifeStraw filter was a problem. 98% said that the filter had not served them for a long period of more than six months. 94% said that the filter was being misused and 68% of the respondents have gone back to boiling since they stopped using Lifestraw filter use.

3.2 Modification by designing a water regulator

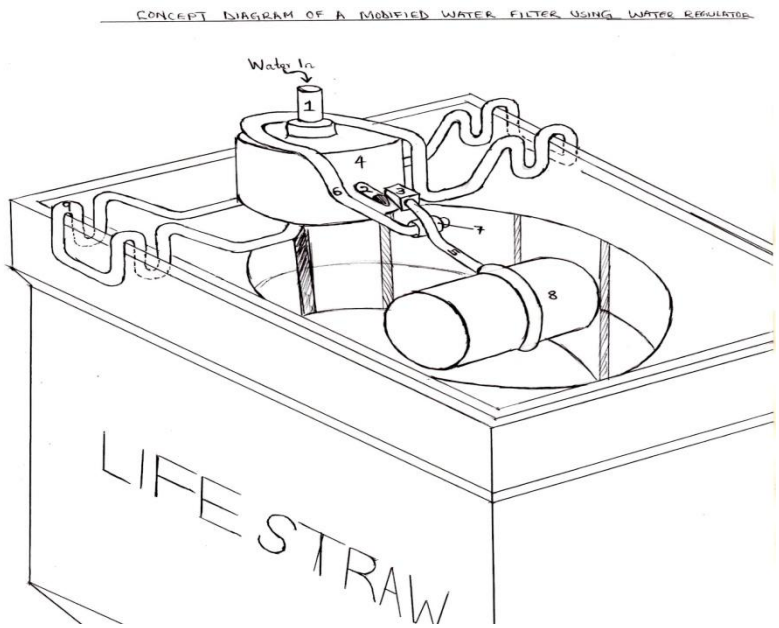

Figure 4

Table 2 Components and functions of different parts of the regulator

No.		Functions
1	Inlet	Connect overhead tank with water regulator and channel water into the accumulator.
2	Outlet /nozzle	Direct water into the filter reservoir.
3	Stopper	Shut and open water flow from the accumulator.
4	Accumulator	Minimize water break by ensuring continuous flow.
5	Arm	Connects the stopper and the floater.
6	Collar	Supports the lever arm (stopper, arm and floater).
7	Fulcrum	Rotary point of the lever arm.
8	Floater	Translate the buoyancy force through the lever arm to control water flow.
9	Clamp	To attach and support the water regulator on the LifeStraw filter.

The water regulator operations depends on water flow from the overhead water tank, into the filter reservoir and more so when the filter is operated by the user (opening and closing the LifeStraw filter taps controls how the regulator operates).The water regulator allows water flow into filter, stops water flow when filter is full and keep the filter full by using buoyancy from water in the filter reservoir as per Archimedes principle. With this installed it means people can continue using the LifeStraw and not start polluting the environment by starting to boil water. Otherwise the carbon credits awarded to the company can be returned because they are not working.

After successful installation of locally crafted water regulator on the life straw filter, water flow from an overhead tank into LifeStraw filter was able to be regulated through various ways highlighted below;

- ✓ Allow water to flow freely into the life straw filter to capacity.
- ✓ Shut water flow when filter reservoir was full to avoid overflow.
- ✓ Kept the filter reservoir full throughout the filtering process.
- ✓ Adequate amount of clean drinking water was collected at the end of the filtering process since there is constant supply of water aided by the water regulator.
- ✓ Close supervision of the LifeStraw filter during filtering process was minimised.

The automation of the filter will ease the work of refilling manually hence minimizing dumping of lifestraw filter.

Embracing the modification will encourage the reuse of plastics.

This will however lead to sustainability on both lifestraw 1.0 filter and environment

IV. CONCLUSION

In Mumias area of western Kenya people were given Lifestraw family, however, the people have stopped using them because of difficulty in refilling. In this paper we have modified the lifestraw by incorporating a storage tank that feeds the filter via a water regulator ensuring automatic and continuous filtration process. It is hoped that the modified straw will augment the achievements and use of the Lifestraw family.

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Clement Kiprotich Kiptum*. "Modified Lifestraw water Filter for Use in Western Kenya." International Journal of Research in Engineering and Science (IJRES), vol. 05, no. 09, 2017, pp. 07–10.